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Effect of developmental care for very premature infants on neurodevelopmental outcome at 2 years of age

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ABSTRACT

Background: To determine the effect of developmental care on neurodevelopmental outcome in formerly preterm infants at a corrected age of 2 years.
Methods: A prospective phase-lag study was performed at an Austrian neonatal intensive care unit (NICU). From January 2003 to December 2005 (study period of conventional care) and January 2007 to December 2009 (study period of developmental care), we enrolled all infants born in Tyrol at less than 32 weeks of gestation. During this period a total of 261 of 359 preterm infants (participation rate 72.7%) completed the follow-up visit at 2 years of age; there were 124 children in the conventional and 137 in the developmental care group. The association between developmental care and delayed motor or mental development (Bayley Scales of Infant Development II; psychomotor or mental developmental index <85) was analyzed by means of logistic regression analysis at a corrected age of 24 months.
Results: Children in the developmental care group showed less psychomotor delay than did those in the control group (developmental care group: 16.1%, conventional care group 27.4%; adjusted odds ratio 0.37 [95% confidence interval: 0.19–0.74], $P = 0.005$). Not smoking in pregnancy and higher gestational age were also significant predictors for a better psychomotor outcome at 2 years of age. Regarding cognitive outcome, no significant difference was observed between these two groups.
Conclusion: Our data implicate that developmental care may result in an improved 2-year psychomotor outcome in formerly preterm infants.

1. Introduction

In European countries 1.1–1.6% of live births are very preterm (Buitendijk, Zeitlin, Cuttini, Langhoff-Roos, & Bottu, 2003). The number of neonates surviving very preterm birth has gradually increased due to advances in perinatal and neonatal care. However, increasing survival is linked to an increased awareness for morbidity with regard to the cognitive and

Abbreviations: ICH, intracranial hemorrhage; MDI, mental developmental index; NEC, necrotizing enterocolitis; NICU, neonatal intensive care unit; NIDCAP®, Newborn Individualized Developmental Care and Assessment Program; PDI, psychomotor developmental index; PVL, periventricular leukomalacia; ROP, retinopathy of prematurity; VLBW, very low birth weight.

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behavioral outcomes of these children (Bhutta, Cleves, Casey, Cradock, & Anand, 2002). It has been proposed that the artificial extrauterine environment at the neonatal intensive care unit (NICU) with exposure to bright lights, high sound levels, and frequent stressful interventions may interfere with an infant's development (Als, 2011; Anand & Scalzo, 2000; Bhutta & Anand, 2002). Therefore, developmental care interventions have been designed to create an environment that minimizes stress experienced by preterm infants in order to further improve their outcome. These interventions may include elements such as control of external stimuli (vestibular, auditory, visual, tactile), clustering of nursery care activities, and positioning or swaddling of the preterm infant. Programs such as the Newborn Individualized Developmental Care and Assessment Program (NIDCAP®), utilize a combination of these strategies depending upon the needs of each infant. These individual needs are assessed by behavioral observations used as a measure of the infant's tolerance to the environment and caregiving activities (Als, 2011). Moreover, the role of mothers in caring for very low birth weight (VLBW) infants has also been emphasized and family-centered care has been strongly advocated (Harrison, 2000). Most follow-up studies of the effectiveness of developmental care are based on trials performed in small samples (seven studies with 26–42 study participants) (Als et al., 1994; Als et al., 2004; Als et al., 2011; Als et al., 2012; Ariagno et al., 1997; Kleberg, Westrup, & Stjernquvist, 2000; Westrup, Böhm, Stjernqvist, & Lagercrantz, 2004), only four trials have larger follow-up sample sizes of 93, 101, 147, and 148 participants (Maguire et al., 2009a, 2009b; McAnulty et al., 2009; Peters et al., 2009). One recently published meta-analysis did not find any evidence that NIDCAP improves neurodevelopmental outcome at 18 months of age (Ohlsson & Jacobs, 2013). Consequently, additional studies on the effect of developmental care with larger sample sizes are necessary.

Moreover, as medical circumstances and cultural background differ between different countries and even within different NICUs in the same country, the aim of the present study was to determine the effect of developmental care interventions in a geographically defined cohort of very preterm infants treated at our NICU.

2. Methods

2.1. Participants

The study survey area was Tyrol, a state in western Austria with 680,000 inhabitants and about 7000 live births per year. All infants born before 32 completed weeks of pregnancy at Innsbruck Medical University Hospital, the only neonatal intensive care unit in the geographical region, were enrolled. Infants born between January 2003 and December 2005 were included in the conventional care group ($n = 250$) and those born between January 2007 and December 2009 in the developmental care group ($n = 208$). In 2006 five nurses and three physicians were specially trained in developmental care (Verveur, Frey, & Pöschl, 2010). This training included an initial 8-day in-hospital course with didactic and hands-on education related to the developmental needs of the preterm infant and focused on understanding of the neonatal development, on optimizing physical environment on NICU and on the incorporation of families into the NICU process. Thereafter, all nursing and medical staff was introduced to theoretical and practical skills in weekly teaching and discussion sessions. Since 2007, after a training period of 1 year, developmental care as standard of care has been offered to each infant at our NICU.

2.2. Conventional and developmental care group treatments

The conventional care group received standard care practices used at the NICU at that time, i.e., primary care nursing, skin-to-skin contact, kangaroo care, promoting breastfeeding, and provision of pacifiers.

The developmental care group underwent adjustment of care and environment by reducing the levels of light using incubator covers and the levels of sound using noise-warning signs (Sound Ears®). These ears turn into red, if a maximum transient sound exceeds 60 dB. Care-giving was concentrated around certain defined periods to allow restful sleep, and preterm infants were positioned or swaddled to provide a sense of containment similar to intrauterine life. Moreover, self-regulatory behaviors such as non-nutritive sucking and grasping were promoted. Regarding parental involvement in addition to early skin-to-skin contact and kangaroo care, parents were included in daily care activities and encouraged to nurture and support their infants during procedures. They were taught to develop such care skills by the nursing staff in special sessions as well as during routine care. During both study periods there were unlimited visiting hours for parents. Detailed observations of the infant's behavior being the basis for recommendations and adaptations optimizing the infant's environment and individual neurodevelopment (Als, 2011) were not performed.

2.3. Maternal and neonatal data

All clinical data were prospectively collected. Maternal and neonatal data included maternal age, maternal years of education, smoking in pregnancy, gestational age (full weeks of gestation), birth weight (grams), multiple birth, sex, postnatal surfactant use, diagnosis of early- and late-onset sepsis, chronic lung disease (CLD), intracerebral hemorrhage (ICH), necrotizing enterocolitis (NEC), and severe retinopathy of prematurity (ROP). Gestational age was calculated from the first day of the last menstrual period. This was compared with assessment of gestational age by ultrasound scans performed before 24 weeks. If there was a difference of more than 1 week between menstrual and ultrasound assessment, the scan assessment was preferred. CLD was defined as oxygen dependence at 36 weeks post-conceptional age. NEC was defined according to Bell's criteria (Bell et al., 1978) and was classified as medical (clinical symptoms and signs plus evidence of pneumatosis on